

what is the total and subsidized cost of the handset, what up-front premiums must be paid to the manufacturer to offset its costs to develop the new handset, and when will chipsets become available to support the new frequency band? The standard method of introducing a new cellular system to interested consumers when the coverage provided by the new carrier is incomplete is by allowing the handset to roam to another mobile network operator in the local area. Thus, roaming agreements with other carriers in other bands using other interfaces must be negotiated, and the handsets provided by the new carrier must support the air interface and frequency requirements of the roaming operator.

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Conclusions

48. As explained above and for the reasons stated, I have concluded as follows:

- In light of the rapidly growing demand for mobile broadband, Verizon Wireless has used appropriate tools to project the demands that such use will increasingly place on its network;
- Verizon Wireless uses a reasonable and appropriate methodology to assess capacity constraints on its network in light of existing spectrum resources and has reasonably concluded that data traffic volumes will outstrip capacity in 2013 in some areas and in 2015 in many more, creating a need to acquire additional spectrum;
- Other methods for expanding network capacity – such as cell splitting, use of femto cells, offloading data traffic to WiFi networks, refarming existing spectrum, and deployment of LTE small cells – alone are insufficient to meet the projected demand;
- The alternative capacity-enhancing approaches suggested in petitions to deny, including software defined radios, mesh networking, channel bonding, use of unlicensed frequencies, and deployment of distributed antenna systems (DAS), are not viable solutions to address the increase in demand;
- SpectrumCo did everything a reasonably diligent new entrant AWS licensee might be expected to do within the first third of its license term and took meaningful steps to develop, use, and identify long-term business plans for the spectrum; and
- SpectrumCo reasonably determined that 20 MHz of AWS spectrum was not enough to fulfill the long-term business plans of its owners, given the fact that SpectrumCo would have been a new entrant constructing a greenfield mobile wireless network intended to provide both voice and advanced data services.

I, David E. Borth, declare under penalty of perjury that the foregoing declaration is true and correct to the best of my knowledge and belief.

Executed on March 2, 2012.



David E. Borth

February 2012

CV of DAVID E. BORTH

HOME ADDRESS

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PERSONAL DATA

Date of Birth: June 17, 1952
Birthplace: Hinsdale, IL
Citizenship: U.S.A.

EDUCATION

University of Illinois at Urbana-Champaign, Urbana, Illinois

- 9/70-1/74 B.S. Degree in Electrical Engineering with Highest Honors, January 1974.
 Advisor: Dr. Edward W. Ernst
- 1/74-6/75 M.S. Degree in Electrical Engineering, October 1975.
 Major Field: Electromagnetic Theory and Bioengineering
 Advisor: Dr. Charles A. Cain
- 8/77-9/79 Ph.D Degree in Electrical Engineering, October 1979
 Major Field: Communication Theory
 Advisor: Dr. Michael B. Pursley

EMPLOYMENT EXPERIENCE

- | | |
|---|------------------------|
| UNIVERSITY OF ILLINOIS-CHICAGO | 2012 to present |
| Professor, Department of Electrical and Computer Engineering | |
| BORTH CONSULTING, LLC, Palatine, IL | 2011 to present |
| Independent consultant to the wireless industry | |
| MOTOROLA INC., Schaumburg, IL | 1980 to 2010 |
| <i>\$21.7B international telecommunications equipment provider.</i> | |

Corporate VP, CTO and Director of Advanced Technology and Research and Emerging Business Office, Enterprise Mobility Solutions (EMS) (2005 - 2010)

Directed advanced technology initiatives impacting government and public safety business as well as new business opportunities in the enterprise space. Played key role as company spokesperson in various trade/government venues in the advanced wireless technology industry. Established technology strategy for government, public safety, and enterprise business. Technologies include wireless broadband (LTE/WiMAX), RF circuits and ICs, security including IA and encryption, communication network architecture, multimedia. Supervised 215 employees in 5 locations across 3 countries.

- Initiated the creation of technology that spawned two new businesses within the EMS organization, the LTE Private Broadband business and the Interoperable Solutions business which will become the cornerstone of the future of the entire EMS organization going forward.
- Initiated the development of the software defined radio platform and corresponding custom integrated circuits which will be used in all of the EMS subscriber radios going forward resulting in projections of significant cost reductions and reduction in inventory.
- Developed a Mission Critical Bluetooth device and security protocols that resulted in the use of existing Bluetooth devices and accessories to be used with public safety radio in a secure manner.
- Achieved FCC ruling in 2010 supporting a new “super WiFi” service based on the reuse of analog TV spectrum by unlicensed access points through the development of the necessary technology and successful demonstration of prototype devices to the FCC in 2007.
- Created the protocols and signal processing methods required to implement the next generation of public safety radios that achieved compliance with FCC mandates after 2011 and led the industry in standardization of these protocols.

Corporate VP and Director, Wireless Access Research, Motorola Labs (2001 - 2005)

Led multi-site, multinational R&D organization focused on advanced communication systems and technologies in the area of wireless access, including mesh/ad hoc, WLAN, sensor/control, 2.5G+and 3.5G, MIMO and OFDM systems. Supported wireless businesses within Motorola with the organization receiving ~30-65 patents/year, generating 125+ standards contributions and ~100+ publications/year. Oversaw 13 labs employing 250+ engineers in the US, France, Australia, Japan and the UK. Managed \$35M+ R&D budget, additionally receiving \$8.5M in external and incubator funding from NIST, DARPA and the European 5th and 6th Framework programs.

- Launched the WiMax product organization through the creation of the necessary technology that resulted in a \$600M/year business. IPR created valued at “several hundred million dollars”.
- Created the technology for EDGE products for both of Motorola’s cellular businesses that resulted in shipment of 30+ million devices per quarter incorporating this technology.

- Developed a video processing technology and hardware architecture which enabled video cameras to be incorporated into cell phones.
- Created a new low-power wireless protocol and corresponding hardware architecture suitable for wireless sensor networks that resulted in this protocol, now known as ZigBee, to be the basis for all of today's smart grid meter reading systems.

VP and Director, Communication Systems and Technologies Labs, Motorola Labs (1998 - 2001)

- Oversaw 13 labs employing 250+ engineers in the US, France, Australia, Japan and the UK. Managed \$35M+ R&D budget, ~\$2.5M in external funding (from the European Union's 5th and 6th Framework Programs), \$1M in U.S. government funding (from various agencies, including NIST, DARPA and others) and ~\$5M in internal incubator funding..
- Developed WAP, a new protocol that permitted cell phones to browse the Internet for the first time, and built the initial prototype that was subsequently included on all cell phones.

VP and Director, Corporate Communication Systems Labs, Corporate R&D (1996 - 1998)

- Initiated work on a true personal communications system using microcell technology. Designs were transferred to a new business – CableComm – and were used to implement Motorola's first cable modem and cable telephony business prior to the acquisition of General instruments in 2001. These same designs were used also in creating Motorola's GPRS proposal.
- Created the Paris Research lab in 1996

Manager, Communication Systems Research Lab, Corp. R&D (1990 - 1996)

- Initiated the study of CDMA technology that resulted in a partnership between Motorola and Qualcomm beginning in 1992. Worked on signal processing algorithms used in Motorola's initial implementation of IS-95 – the CDMA air interface standard. Created a team that developed enhancements to Qualcomm's technology that eventually were adopted in the 1xEVDO.

Technical Staff Member, Systems Research Lab (1980 - 1990)

- Developed entire signal processing and control architecture for Motorola's first GSM system implementations. Designed initial link systems, validation systems and the world's first type-accepted GSM mobile system (in 1991) with the signal processing algorithms still actively employed in all GSM subscriber products and in 1.1B+ GSM phones. Up until approximately 2006, Motorola was selling approximately 45 million handsets per quarter of which more than 75% were GSM phones using this technology. Licensing of patents from this technology development resulted in hundreds of millions of dollars to Motorola.
- Developed the algorithms and led the team the initiated the first Motorola implementation of IS-54 – the U.S. TDMA digital cellular standard. All algorithms

were adopted by the product organizations leading to early roll-out of both base and subscriber TDMA equipment.

- Helped create Motorola's first voice recognition cellular phone to permit truly-hands-free dialing.
- Helped Motorola enter the DSP marketplace via development of algorithms and application notes for the DSP56001.

July 1983 - 1986

Department of Electrical Engineering & Computer Science
University of Illinois at Chicago
Chicago, IL
Adjunct Assistant Professor
Supervised 5 M.S.E.E Projects

September 1979-June 1980:

School of Electrical Engineering,
Georgia Institute of Technology,
Atlanta, GA
Assistant Professor

August 1977 - August 1979:

Coordinated Science Laboratory,
University of Illinois, Urbana, IL
Research Assistant in Communication Theory

June 1975 - July 1977:

Watkins-Johnson Company, Palo Alto, CA
Member of the Technical Staff

PROFESSIONAL REGISTRATION, LICENSES AND CLEARANCES

Registered Professional Engineer, State of Illinois, No. 062-040218

FCC General Radiotelephone Operator License, No. PG-6-12362

Amateur Radio License, Extra Class N9KYZ

DoD Secret Clearance

FELLOWSHIPS & AWARDS

- Elected to National Academy of Engineering, 2004

- Fellow (1997), Institute of Electrical and Electronics Engineers (member 1970 - present)
- Motorola Regional Patent of the Year Award, Motorola Labs, 2001, U.S. Patent 4,852,090
- Distinguished Alumnus Award from the University of Illinois Electrical and Computer Engineering Alumni Association, Urbana, IL, September 1995
- Recipient of 1995 Master Innovator Award from Motorola (25 or more issued patents)
- Recipient of 1992 Distinguished Innovator Award from Motorola (10 or more issued patents)
- Elected Motorola Dan Noble Fellow 1990 (Highest technical award of Motorola Inc.)
- Elected member of Motorola Science Advisory Board Associates (SABA) 1989

University of Illinois Fellow
 National Institutes of Health Fellowship
 Bronze Tablet
 Outstanding Senior Award, Eta Kappa Nu
 Edmund J. James Scholar

University of Illinois 1977-1978
 University of Illinois 1975
 University of Illinois 1974
 University of Illinois 1974
 University of Illinois 1970-1973

Honorary Societies: Phi Eta Sigma, Tau Beta Pi, Eta Kappa Nu, Phi Kappa Phi

THESES

M.S.: The Generation of Acoustic Signals in Materials by Irradiation with Microwave Pulses, August 1975.

Ph.D.: Performance Analysis of Direct-Sequence Spread-Spectrum Multiple-Access Communication via Fading Channels, September 1979. Dissertation abstract appears in **IEEE Transactions on Information Theory**, vol. IT-26, pp. 508-509, July 1980.

JOURNAL AND CONFERENCE PAPERS

1. D. Borth, R. Ekl, B. Oberlies, and S. Overby, "Considerations for Successful Cognitive Radio Systems in US TV White Space," *New Frontiers in Dynamic Spectrum Access Networks, 2008 (DySPAN 2008)*, pp. 1-5, Chicago, IL, USA, October 14-17, 2008.
2. D. E. Borth, P. D. Rasky, G. M. Chiasson, and J. F. Kepler, "Frequency Hopped Systems for PCS," *Proceedings of the 1994 IEEE International Symposium on*

- Spread Spectrum Theory and Applications*, pp. 105-114, Oulu, Finland, July 4-6, 1994.
3. P. D. Rasky, G. M. Chiasson, D. E. Borth, and R. L. Peterson, "Slow frequency-hop TDMA/CDMA for macrocellular personal communication systems," *IEEE Personal Communications*, vol. 1, pp. 26-35, Second Quarter, 1994. Reprinted in *Cellular Radio & Personal Communications*, vol. 2, *Advanced Selected Readings*, T. S. Rappaport, ed. Piscataway, NJ: IEEE Press, 1996.
 4. Phillip D. Rasky, Greg M. Chiasson and David E. Borth, "Hybrid Slow Frequency-Hop/CDMA-TDMA as a Solution for High-Mobility, Wide-Area Personal Communications," *Proceedings of the Fourth Winlab Workshop on Third Generation Wireless Information Networks*, pp. 199-215, East Brunswick, New Jersey, October 19-20, 1993.
 5. Phillip D. Rasky, Greg M. Chiasson, and David E. Borth, "An Experimental Slow Frequency-Hopped Personal Communication System for the Proposed U.S. 1850-1990 MHz Band," *Proceedings of the Second International Conference on Universal Personal Communications*, pp. 931-935, Ottawa, Canada, October 12-15, 1993.
 6. Phillip D. Rasky, Greg M. Chiasson and David E. Borth, "Slow Frequency-Hopped CDMA for High-Mobility Personal Communication Systems," (Invited Paper) *Proceedings of the Thirty-First Annual Allerton Conference on Communication, Control, and Computing*, pp. 325-334, Monticello, Illinois, September 29-October 1, 1993.
 7. Kevin L. Baum, David E. Borth, and Bruce D. Mueller, "A Comparison of Nonlinear Equalization Methods for the U.S. Digital Cellular System," *Proceedings of the 1992 International Conference on Communications*, pp. 312.1.1-312.1.5, June 15-17, 1992.
 8. Joseph M. Nowack, David E. Borth, and Phillip D. Rasky, "Soft-Output MLSE Equalization Methods for the Mobile Radio Channel," (Invited Paper) *Proceedings of the Twenty-Ninth Annual Allerton Conference on Communication, Control, and Computing*, pp. 11-20, October 2-4, 1991.
 9. David E. Borth and Phillip D. Rasky, "Signal Processing Aspects of Motorola's Pan European Digital Cellular Validation Mobile," (Invited Paper) *Proceedings of the 1991 IEEE International Phoenix Conference on Computers and Communications*, pp. 416-423, March 27-30, 1991.
 10. John R. Haug, David E. Borth, Kevin L. Kloker, and Carol W. Wu, "A DSP-Based Stereo Decoder for Automotive Radio," *Proceedings of the 1990 SAE International Congress and Exposition*, paper 900244, Detroit, MI, February 27, 1990.
 11. David E. Borth and Phillip D. Rasky, "An Experimental RF Link System to Permit Evaluation of the GSM Air Interface Standard," *Proceedings of the Third Nordic Seminar on Digital Land Mobile Radio Communication*, paper 6.3, Copenhagen, Denmark, September 12-15, 1988.
 12. David E. Borth, Ira A. Gerson, John R. Haug, Charles D. Thompson, "A Flexible Adaptive FIR Filter VLSI IC," *IEEE Journal on Selected Areas in Communications*, vol. SAC-6, pp. 494-503, April 1988.

13. David E. Borth, Ira A. Gerson, and John R. Haug, "A Cascadable Adaptive FIR Filter VLSI IC," *Proceedings of the 1987 IEEE International Conference on Acoustics, Speech, and Signal Processing*, pp. 13.11.1-13.11.4, Dallas, TX, April 1987.

14. David E. Borth, Michael J. McLaughlin, and James J. Mikulski, "Implementation of a Digital Mobile Radio Incorporating Combined Modulation/Coding," *Proceedings of the Second Nordic Seminar on Digital Land Mobile Radio Communication*, pp. 85-89, Stockholm, Sweden, October 14-16, 1986.
15. David E. Borth, "Digital Signal Processing Estimates for Two Digital Time-Division Multiple Access Methods," *Proceedings of the CEPT/GSM Workshop on VLSI Requirements for the Pan-European Cellular Radio System*, September 25-26, 1986.
16. Zohar Raz and David E. Borth, "A Digital Signal Processing Approach to Multichannel Television Sound Decoding," *IEEE Transactions on Consumer Electronics*, vol. CE-32, pp. 453-462, August 1986.
17. Zohar Raz and David E. Borth, "Digital MTS System," *Proceedings of the 1986 IEEE International Conference on Consumer Electronics*, session VII, pp. 98-99, Rosemont, IL, June 4-6, 1986.
18. David E. Borth, "Modified Phase-Shift Keying -- A New Line Code for Digital Subscriber Loops," *Electronics Letters*, vol. 22, no. 5, pp. 243-245, February 27, 1986.
19. Richard A. Comroe and David E. Borth, "Digital Subscriber Loop Synchronization Technique," *Motorola Technical Developments*, vol. 3, pp. 27-28, March 1983.
20. D. E. Borth, M. B. Pursley, D. V. Sarwate, and W. E. Stark, "Bounds on Error Probability for Direct-Sequence Spread-Spectrum Multiple-Access Communications" *1979 MIDCON Conference Proceedings*, pp. 15/1-1--15/1-14, November 1979.
21. D. E. Borth, "Quadrphase Direct-Sequence Spread-Spectrum Multiple-Access Communication via Fading Channels," *Proceedings of the Seventeenth Annual Allerton Conference on Communication, Control, and Computing*, pp. 112-121, October 1979.
22. D. E. Borth and M. B. Pursley, "Analysis of Direct-Sequence Spread-Spectrum Multiple-Access Communication over Rician Fading Channels," *IEEE Transactions on Communications*, vol. COM-27, pp. 1566-1577, October 1979.
23. D. E. Borth and M. B. Pursley, "Spread-Spectrum Communication via Fading Channels," *Abstracts of the 1979 IEEE International Symposium on Information Theory*, Grignano, Italy, p. 22, June 25-29, 1979.
24. D. E. Borth and M. B. Pursley, "Direct-Sequence Spread-Spectrum Multiple-Access Communication for a Class of Rician Fading Channels," *Proceedings of the National Telecommunications Conference*, vol. 3, pp. 35.2.1-35.2.6, December 1978.
25. D. E. Borth and C. A. Cain, "Theoretical Analysis of Acoustic Signal Generation in Materials Irradiated with Microwave Energy," *IEEE Transactions on Microwave Theory and Techniques*, vol. MTT-25, pp. 944-954, November 1977.

26. D. E. Borth and C. A. Cain, "The Microwave Hearing Effect--A Theoretical Analysis," *Abstracts of the USNC/URSI Meeting*, University of Illinois, Urbana, Illinois, p. 103, June 3-5, 1975.
27. D. E. Borth and C. A. Cain, "The Generation of Acoustic Signals in Materials Irradiated with Microwave Pulses," *Proceedings of the Microwave Power Symposium 1975*, University of Waterloo, Waterloo, Ontario, Canada, pp. 95-98, May 28-30, 1975.

BOOKS

"Hybrid Slow Frequency-Hop/CDMA-TDMA as a Solution for High-Mobility, Wide-Area Personal Communications," Phillip D. Rasky, Greg M. Chiasson, and David E. Borth, in **Wireless and Mobile Communications**, Jack M. Holtzman and David J. Goodman, editors. Boston: Kluwer Academic Publishers, 1994.

"Frequency Hopped Systems for PCS," D. E. Borth, P. D. Rasky, G. M. Chiasson, and J. F. Kepler, in **Code Division Multiple Access Communications**, S. Glisic and Lappenen, editors. Boston: Kluwer Academic Publishers, 1995.

"An Overview of Personal Communication Systems," David E. Borth, in **Microsystems Technology for Multimedia Application: An Introduction**, Bing Sheu, Mohammed Ismail, Edgar Sanchez-Sinencio, editors. New York: IEEE Press, 1995.

Roger L. Peterson, Rodger E. Ziemer, and David E. Borth, **Introduction to Spread-Spectrum Communications**. Englewood Cliffs, NJ: Prentice-Hall, 1995. Translated into Japanese and republished in Japan in 2002 by Science & Technology Press, Inc.

David E. Borth, "The Telephone," **Encyclopaedia Britannica**, 1997. Updated 2002.

David E. Borth, James S. Lehnert, Wayne S. Stark, "Principles of Telecommunications," **Encyclopaedia Britannica**, 1997.

ISSUED U.S. PATENTS (113 Patents Worldwide)

1. U. S. Patent 4,628,529, "Improved Noise Suppression System," December 9, 1986, David E. Borth, Ira A. Gerson, and Richard A. Vilmur, (disclosed as CM00234H).
2. U. S. Patent 4,630,304, "Automatic Background Noise Estimator for a Noise Suppression System," December 16, 1986, David E. Borth, Ira A. Gerson, and Richard A. Vilmur, (disclosed as CM00143H).
3. U. S. Patent 4,630,305, "Automatic Gain Selector for a Noise Suppression System," December 16, 1986, David E. Borth, Ira A. Gerson, Philip J. Smanski, and Richard A. Vilmur, (disclosed as CM00235H).

4. U. S. Patent 4,723,288, "Stereo Decoding by Direct Time Sampling," February 2, 1988, David E. Borth, Kevin L. Kloker, and James J. Mikulski, (disclosed as SC-05624A).
5. U. S. Patent 4,737,976, "Hands-Free Control System for a Radiotelephone," April 12, 1988, David E. Borth, Ira A. Gerson, and Richard A. Vilmur, (disclosed as CM00156H).
6. U. S. Patent 4,775,851, "Multiplierless Decimating Low-Pass Filter Circuit For a Noise-Shaping A/D Converter," October 4, 1988, David E. Borth, (disclosed as CM00356H).
7. U. S. Patent 4,829,543, "Phase-Coherent TDMA Quadrature Receiver for Multipath Fading Channels," David E. Borth, Chih-Fei Wang, Duane C. Rabe, and Gerald P. Labedz, May 9, 1989, (disclosed as CE00398H).
8. U.S. Patent 4,847,869, "Rapid Reference Acquisition and Phase Error Compensation for Radio Transmission of Data," July 11, 1989, Gerald P. Labedz and David E. Borth, (disclosed as CM00368H).
9. U. S. Patent 4,852,090, "TDMA Communications System with Adaptive Equalization," July 25, 1989, David E. Borth, (disclosed as CM00334H).
10. U. S. Patent 4,876,683, "TDMA Radio System Employing BPSK Synchronization for QPSK Signals Subject to Random Phase Variation and Multipath Fading," October 10, 1989, David E. Borth, Chih-Fei Wang, Duane C. Rabe, and Gerald P. Labedz, (disclosed as CE00027R).
11. U. S. Patent 4,887,050, "Frequency Control Apparatus and Method for a Digital Radio Receiver," December 12, 1989, David E. Borth and James F. Kepler, (disclosed as CE00158R).
12. U. S. Patent 4,910,470, "Digital Automatic Frequency Control of Pure Sine Waves," March 20, 1990, David E. Borth and James F. M. Kepler, (disclosed as CE00130R).
13. U.S. Patent 5,121,412, "All-Digital Quadrature Modulator," June 9, 1992, David E. Borth, (disclosed as CM00451H).
14. U.S. Patent 5,133,010, "Method and Apparatus for Synthesizing Speech Without Voicing or Pitch Information," David E. Borth, Ira A. Gerson, Richard J. Vilmur, and Brett L. Lindsley, July 21, 1992 (disclosed as CM00249G).
15. U.S. Patent 5,142,551, "Signal Weighting System for Digital Receiver," August 25, 1992, David E. Borth, Phillip D. Rasky, Fuyun Ling and M. Vedat Eyuboglu (disclosed as CE00399R).
16. U. S. Patent 5,144,644, "Soft Trellis Decoding," September 1, 1992, David E. Borth, (disclosed as CE02086R).
17. U.S. Patent 5,214,675, "System and Method for Calculating Channel Gain and Noise Variance of a Communication Channel," May 25, 1993 Bruce D. Mueller, Kevin L. Baum, David E. Borth, Phillip D. Rasky, and Eric H. Winter (filed as CE-00409R).

18. U. S. Patent 5,233,632, "Communication System Receiver Apparatus and Method for Fast Carrier Acquisition," August 3, 1993, Kevin L. Baum, David E. Borth, and Phillip D. Rasky (filed as CM-0731H).
19. U.S. Patent 5,263,052, "Viterbi Equalizer for Radio Receiver," November 16, 1993, David E. Borth, Bruce D. Mueller and Kevin L. Baum, (disclosed as CE-00512R).
20. U. S. Patent 5,271,042, "Soft Decision Decoding with Channel Equalization," December 14, 1993, David E. Borth, Gerald P. Labedz, and Phillip D. Rasky, (disclosed as CE-02049R).
21. U. S. Patent 5,276,685, "Digital Automatic Gain Control," January 4, 1994, James F. M. Kepler, David E. Borth, and Frank J. Cerny, (disclosed as CE-121R).
22. U. S. Patent 5,301,364, "Method and Apparatus for Digital Automatic Gain Control in a Receiver," April 5, 1994, John W. Arens, David E. Borth, and James F. M. Kepler (disclosed as CE0332R).
23. U.S. Patent No. 5,379,324, Continuation in part of "Soft Decision Decoding for Fading Radio Channels Incorporating Pi/4 DQPSK," January 3, 1995, Bruce D. Mueller, Kevin L. Baum, David E. Borth, Phillip D. Rasky, and Eric H. Winter (disclosed as CE0409RD1 (June 25, 1991)).
24. U. S. Patent 5,381,443 "Method and Apparatus for Frequency Hopping a Signalling Channel in a Communication System," January 10, 1995, David E. Borth, John R. Haug, and Phillip D. Rasky (disclosed as CE-02376R (April 16, 1992))
25. U. S. Patent 5,392,300 "A Dual Mode Radio Communication Unit," February 21, 1995, David E. Borth, John R. Haug, Phillip D. Rasky, and Greg M. Chiasson (disclosed as CE-2370R) (April 16, 1992))
26. European Patent EP-B1-0373405 "AFC on Data", December 1995, David E. Borth, James F. Kepler (disclosed as CE00124R).
27. U. S. Patent 5,574,973, "Method of Registering/Reassigning a Call in a Dual Mode Communication Network, November 12, 1996, David E. Borth, John R. Haug, and Phillip D. Rasky.
28. United States Patent 5,712,868, "Dual mode communication network," January 27, 1998, Morton Stern, John S. Csapo, David Edward Borth, Charles N. Lynk, Jr., John Richard Haug, Eric R. Schorman, Phillip David Rasky, Walter Joseph Rozanski, Jr (filed June 30, 1992)
29. U.S. Patent 5,737,327, "Method and Apparatus for Demodulation and Power Control Bit Detection in a Spread Spectrum Communication System," April 7, 1998, Fuyun Ling, David E. Borth, Colin D. Frank, Phillip D. Rasky, James F. Kepler.

30. U.S. Patent 5,878,324, "Method & System for Distribution of Wireless Digital Multi-Media Signals in a Cellular Pattern," March 21, 1999, David E. Borth, John Major, William Braun, James J. Mikulski.

31. U.S. Patent 6,111,923, "System and Method for Calculating a State Transition Metric in a Viterbi Equalizer," August 29, 2000, Bruce D. Mueller, David E. Borth, Kevin L. Baum.

IEEE ACTIVITIES

- Member of Technical Program Committee, ICC'85 (COMSOC)
- Session Chairman and Organizer, IEEE 1985 International Conference on Communications, June 1985.
- Chairman and session organizer, ICC'92 (COMSOC)
- Presented a one-hour tutorial on Personal Communication Systems at IEEE ISCAS'95 (Circuits and Systems Society)
- Member of the Technical Program Committee, VTC'95 (VTS)
- Member of the Technical Program Committee, 1996 International Symposium on Spread Spectrum Theory and Applications (ISSSTA'96) (COMSOC)
- IEEE Paper Reviewer, October 1979 - present: Reviewed papers submitted to IEEE Transactions on Communications, IEEE Transactions on Vehicular Technology, and IEEE Transactions on Education and associated conferences
- Member, Communication Theory Committee, IEEE Communications Society, 1989 -.
- Finance Chair, 2003 IEEE Wireless Communications and Networking Conference, March 16-20, 2003.

NATIONAL RESEARCH COUNCIL ACTIVITIES

- Peer review committee, National Academy of Engineering, 2010-2013
- National Academies Panel on Digitization and Communications Science review of the Army Research Laboratory (ARL) in Adelphi, MD. 2009-2010, 2011-2012
- Review of NRC Report "Toward a Universal Radio Frequency System for Special Operations Forces," 2009. (Note that this report is Exempt for Mandatory Disclosure under the Freedom of Information Act, 5 U.S.C. 552(b).)
- Wireless Technology Prospects and Policy Options Panel sponsored by the Computer Science and Telecommunications Board. 2003-present
- National Research Council Board on Laboratory Assessments, Panel on Electronics and Electrical Engineering, Review of Electronics and Electrical Engineering Laboratory of the National Institute of Standards and Technology (NIST), 2007, 2009.
- Review of NRC report Rising to the Situation: IT-Enabled Transformation of Disaster Management, September 20, 2006 (forthcoming NRC report)

- Review of NRC report Science and Technology to Counter Terrorism -The Proceedings of an Indo-U.S. Workshop, September 6, 2006 (NRC report released March 2007)
- Review of Computer Science and Telecommunications Board – June 2006
- NRC Naval Studies Board: Reviewer: 2003
- NRC Committee on Science and Technology for Countering Terrorism: Panel on Information Technology (Branscomb-Klausner Report): 2001-2002. This panel produced the two reports: “Making the Nation Safer – The Role of Science and technology in Countering Terrorism,” (National Academies Press, 2002) and “Information Technology for Counterterrorism: Immediate Actions and Future Possibilities,” (National Academies Press, 2003).
- NRC Computer Science and Telecommunications Board (CSTB): 2000-2003. Reviewed numerous reports and studies during this period.

OTHER BOARDS AND COMMITTEES

- U.S. Department of Commerce Spectrum Management Advisory Committee (chaired successively by John Kneuer, Meredith Baker and Larry Stickling head of NTIA and Assistant Secretary of Commerce for Communications and Information), Special Government Employee appointed by U.S. Commerce Secretary Carlos M. Gutierrez: 2006-present
- Federal Communications Commission Technological Advisory Committee, 2005-2006
 - National Science Foundation: Committee of Visitors, 2000
 - University of Illinois at Urbana-Champaign: Director of the Motorola Center for Communications. 1999-2005
 - Midwest vice president of the Electrical and Computer Engineering Alumni Association of the University of Illinois 2001-2004.
 - Northwestern University: member of the board of directors of the Northwestern Center for Telecommunications, 1999-2002
 - University of Michigan: member of the National Advisory Council of the Department of Electrical Engineering and Computer Science, 1999-2002
 - Wireless World Research Forum (an international forum of 60+ companies/institutions focusing on wireless communications beyond 3G (B3G)): Vice Chairman and Founding Member 2001-2003

EXTERNAL PRESENTATIONS –A PARTIAL LIST

1. “Next Generation Public Safety (Keynote address)”, Motorola EMS North America 2010 Consultant Seminar - Day 2 Keynote, May 20, 2010.

2. "Next Generation Public Safety Communications," to the U.S. National Security Agency, 140 National Business Parkway Annapolis Jct, MD 20701 , April 1, 2010.
3. "Next Generation Public Safety (Keynote address)," APCO Australasia Conference, Melbourne, Australia, March 15, 2010.
4. "Next Generation Public Safety Communications – Progress, Challenges and Future," to the Office of Emergency Communications, Department of Homeland Security, Washington, DC, February 28, 2010.
5. Motorola Briefing to Electronic Warfare Technology Task Force Workshop, Naval Research Lab, December 9, 2009.
6. "FCC Broadband Taskforce Research Recommendations Workshop, (Invited speaker)" FCC, Washington, DC November 23, 2009.
7. Motorola Briefing on Smart Grid and Smart Grid Security to DTE Energy CIO (Lynne Ellyn), Detroit, MI, November 11, 2009.
8. "LTE and Public Safety," to FCC Public Safety and Homeland Security Bureau Chief Jamie Barnett, Washington, DC, October 27, 2009.
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Exhibit 4

Declaration of Michael L. Katz

**AN ECONOMIC ASSESSMENT OF ARGUMENTS MADE BY
OPPONENTS TO SPECTRUMCO'S AND COX'S PROPOSED
LICENSE ASSIGNMENTS TO VERIZON WIRELESS**

Declaration of Michael L. Katz

March 1, 2012

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